FORTY NOTIFIABLE DISEASES

A SIMPLE DISCUSSION OF THE MORE IMPORTANT COMMUNICABLE DISEASES

BY

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THE HOUSE OF APPLIED KNOWLEDGE

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Our knowledge of infections and how to prevent them is now so definite and so complete that in this field of hygiene we are able to rest most of our practices on a sure basis of scientific truth. In consequence our victories over these causes of illness have been overwhelming, and with the wider application of our knowledge even more startling results will be secured. Publisher and editor have pleasure in offering in *Forty Notifiable Diseases* a brief compend of important facts concerning communicable diseases that should be a part of the information possessed by every American citizen. The author is an experienced and practical worker who knows exactly where effort should be directed to secure a maximum health return.

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PREFACE

HYGIENE as a subject of general education has taken on a new importance since the war. Every year sees it introduced into more and more colleges and universities, and with equal pace it is making more and more definite inroads into the curricula of the secondary schools.

But the subject matter is still unformed. Hardly any two schools or individuals are approaching it from the same angle. This condition grows quite naturally out of the largeness of the subject and the multiplicity of choices of material for emphasis. Out of this situation comes the author's belief that the time has arrived when we can profitably begin the work of standardization.

Upon the theory that hygiene should ultimately eliminate premature deaths and unnecessary suffering and at the same time promote human efficiency, it seems logical to direct our formative efforts toward the points that are most likely to yield immediate returns.[1] Those who have studied the subject most — the health authorities — have, by common consent, addressed themselves chiefly to the definite group of diseases that forms the subject matter of this little book.

[1] In the University of Alabama we devote one hour a week for one year to hygiene as a required subject. Experience has shown that in that time the students can acquire a "thinking knowledge" of the notifiable diseases and a working knowledge of nutrition and elimination. That is all we are undertaking to accomplish in this course.

It might be asserted that an adequate treatment of the diseases presupposes a working knowledge of biology that is not always available, even among college groups. Yet it is believed that it is possible to give to those denied such preliminary preparation at least a thorough grounding in the principal facts connected with these diseases.

The idea behind the publication of this book is, then, to set forth only those salient facts of the subject that the layman can reasonably be expected to assimilate, but at the same time, if possible, to include all the facts and ideas that are really important for him to know and to express them in such simple form as to enable him to begin to master them before college or even high school is reached.

No apology is offered for the diminutive size of the book; but if it be challenged upon the ground that the language is too juvenile for grown-ups, then answer is made that before beginning the work a painstaking examination was made of over 2000 people, including college students and professors, medical students, nurses, lawyers, and teachers, and as a result of that examination the conclusion was reached that there is far graver danger of shooting over the head than under the feet.

H. B.

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'Tis his at last who says it best —
I'll try my fortune with the rest.

LOWELL

INTRODUCTORY

Most of the notifiable diseases are caused by germs of one kind or another; hence, first of all, the chapter "About Germs" should be read carefully and thoughtfully, and, if necessary, re-read.

Then comes the list of "Forty Notifiable Diseases." To most persons the very names of these diseases look formidable, and instead of getting down to business and learning them, these persons call them "any old thing" and pass them by. *It should be understood at the outset that one cannot learn hygiene without learning its language.* Furthermore, as soon as one becomes serious about learning the language of hygiene, the difficulties all fade away. It is true, "poliomyelitis" is a long word, but it is not so long as "Constantinople," and who cannot spell and pronounce "Constantinople"? So many medical terms are built up from familiar components that as soon as the structure of one of these words is noted, the meaning becomes at once apparent. For example, all the "itises" are simply inflammations, as inflammation of the appendix, of the bronchi, of the tonsils, or of the colon (lower bowel); "hem" or "em" has reference to blood, as an*em*ia (without blood), hyper*em*ia (too much blood, congestion), *hem*orrhage (a flowing of blood), or *hem*aturia (blood in the urine); all the "zos" pertain to animals, as *Zoölogy;* all the "phytes" pertain to plants, as epi*phyte* (upon a plant); the "hypers" mean "over," or too much, as *hyper*sensitive, *hyper*tension; the "hypos" mean "under," as *hypo*dermic (under the skin); and

"derma" means "the skin," as epi*derm* (upon the skin), or *derma*phyte (a skin plant, of which the mold-like plants that cause "ringworms" are good examples).

So after reading the chapter "About Germs," it is urged that the names of these "forty notifiable diseases" be learned thoroughly — the spelling, the pronunciation, and above all the *meaning*. Throughout the course a dictionary may be used to advantage.

At the head of the list of diseases, the term "Registration Area" is used. Stop and find out what that term means before proceeding further. Incidentally scan the list and decide for yourself which are the most important diseases in it.

It will be noted that many of these diseases are treated in groups. This grouping is a teaching device and is admittedly more or less artificial.

Although the language of hygiene is insisted on, at the same time technical terms have been avoided in the work as far as possible.

CHAPTER ONE

About Germs

There is probably no word in the English language more widely misunderstood than the word "germ." This wholesale misunderstanding clusters chiefly around four points — the idea that germs are universally "mean," their size, their numbers, and the way they travel.

A little history will help to clarify some points. It was Louis Pasteur who started all the talking and writing about germs and bacteria and microbes that has taken place during the past forty or fifty years. When, away back in the '60's, a great epidemic disease struck the silkworms of France and was playing greater havoc with the silkworm industry than the boll weevil is with the cotton industry in our own country, Pasteur took up the disease, hoping to find its cause and possibly how to prevent it. He soon found in the sick silkworms tiny little bodies that were not in the well worms. These little bodies were alive. He found that if some of them were put on the food of the well worms, these worms soon got sick with the same disease and that the same kind of little bodies could then be found in them. In fine, *he had discovered germs.* This was the first time in the world that it was definitely proved that little living things caused disease.

It was not long after this that Koch discovered that consumption in human beings was also caused by little living things or "germs." Soon Hansen found that leprosy was caused by germs. Klebs

proved that diphtheria was a germ disease, and Eberth found the germ that caused typhoid. By this time it was generally recognized that *all communicable disease is caused by living organisms.*

All these findings were noted in the papers, and people began to read and ponder. At that time a "germ" was supposed to be about the worst thing in the world. Nurses used to frighten the babies by telling them that if they did not hush, a "germ" would get them. No one ever heard in popular literature of a good germ — no one ever thought of one even.

But there *are* good germs, nevertheless. They outnumber the bad ones by far. They do a great deal more good than the bad ones do harm. It is only through the agency of "germs" that wine and beer can be made. Wine and beer are in bad repute, but germs are still useful. All the plain and fancy cheeses are made through the agency of germs. Whenever you take a vanilla soda or vanilla ice cream, you pay tribute to germs, for the vanilla bean has to be fermented before the vanilla flavor is developed. In the preparation of linen, the flax has to undergo a process of fermentation called "retting."

But, more important than all this, it is now understood that germs are of inestimable value to agriculture. Germs take from the air free nitrogen, which plants cannot use, and build it up into nitrates that can be used by plants; and in turn animals obtain these nitrates by eating the plants. Then,

when these plants and animals die, other germs tear their bodies down and let loose the nitrogen once again. Thus the air is kept supplied with its full amount of nitrogen. Even the nitrates that leak away into the rivers and seas are attacked there by germs that break up these nitrates and release their nitrogen so that it flows again into the air.

This circle of changes through which nitrogen passes is known as the *nitrogen cycle,* and were it not for the germs, the cycle would be broken. When an animal or plant died, instead of being broken down and its nitrogen released for further use by other plants and animals, it would remain in a state of preservation indefinitely. The atmospheric nitrogen would be all tied up in these dead organisms, and the circulation of nitrogen in the world would cease forever. So whenever you are tempted to think ill of a germ, remember that all life depends for its existence on the activities of these little germs. Oh, yes, there are a few dozen harmful ones, it is true, but there are hundreds that are beneficial.

The second great misunderstanding about germs concerns their size. The untrained find it difficult to think of anything as small as a germ really is. They think to a certain point in littleness, and then when they try to think of anything smaller, first doubt and then incredulity creeps in.

But really germs are as small as the bacteriologists say they are. For example, the germs of tuberculosis, which are shaped about like corncobs, are so small that, laid end to end, it would take 10,000 to measure

an inch, and laid side by side, it would take 80,000 to measure an inch! A mass of tuberculosis germs as large as a drop of water could contain enough for every man, woman, and child on the face of the earth to have one apiece, and even then some would be left over. A patient in an advanced stage of tuberculosis might cough up and spit out enough germs every day to infect every person in the world a thousand times over.[1]

We often speak of germs *growing*. We do not exactly mean by that that they get larger; we mean rather that they increase in numbers. They do this very rapidly. As a matter of fact they do grow a little in size; but they soon break in two, and each half becomes a new germ. In turn, each one of these new germs grows in size a little and breaks again, and so on. Under favorable conditions it takes them only about 20 minutes to grow a little and break in two. Suppose one were grown under favorable conditions, how many would come from it in 24 hours?

Starting	at	12.00	o'clock,	we	should	have	1 germ
"	"	12.20	"	"	"	"	2 germs
"	"	12.40	"	"	"	"	4 "
"	"	1.00	"	"	"	"	8 "
"	"	1.20	"	"	"	"	16 "
"	"	1.40	"	"	"	"	32 "
"	"	2.00	"	"	"	"	64 "
"	"	2.20	"	"	"	"	128 "
"	"	2.40	"	"	"	"	256 "

[1] Thousand in this sense is used only as a figure of speech; it is not an overstatement, but actually an understatement.

Starting at	3.00	o'clock,	we	should	have	512	germs
" "	3.20	"	"	"	"	1,024	"
" "	3.40	"	"	"	"	2,048	"
" "	4.00	"	"	"	"	4,096	"
" "	4.20	"	"	"	"	8,192	"
" "	4.40	"	"	"	"	16,384	"

A. Fischer has completed the calculation for the 24-hour period and states that at the end of this period there would be 1600 trillion new germs! But it is only when they have the right kind of nutrition and environment that they multiply at such a rate — or at all, for that matter.

A knowledge of their smallness and numbers paves the way for an understanding of their methods of travel. You know how easily coal dust sticks to a person's skin or to clothes. You know also how dirt rubs off and soils other things with which it comes in contact, and how such dirt is thus carried from place to place. That is about the way germs travel — not such aristocratic germs as malarial parasites, that travel by "flying machines," as we shall learn later, but the common germs of tuberculosis or diphtheria, which have to get around in the best way they can.

Germs may be either small plants or small animals. The ones most commonly met with are little plants that are called *bacteria* (singular, *bacterium*). The simplest and most common form encountered among these is the spherical. A spherical bacterium is called a *coccus* (plural, *cocci*).

In reproducing, a coccus grows a tiny bit and then splits in half. Sometimes these two halves do not

separate entirely but cling together, giving the appearance of two cocci fastened tightly to each other. Groups of cocci arranged like this are called *diplococci*. Three of our forty diseases are caused by diplococci; namely, meningitis, gonorrhea, and pneumonia.

Sometimes the cocci, instead of arranging themselves in twos, arrange themselves in a long chain, like a string of beads. This arrangement of cocci is called *streptococci*. None of our notifiable diseases are known to be caused by streptococci, but erysipelas and puerperal (childbed fever) are caused by this group of cocci. Occasionally streptococci also attack the throat, causing distressing symptoms.

Sometimes the cocci arrange themselves in clusters like a bunch of grapes. Grouped thus, they are called *staphylococci*. It is the germs of this group that commonly cause boils.

Others of these vegetable germs, instead of being round, are rod-shaped, something like a corncob. Such germs are called *bacilli* (singular, *bacillus*). The germs of tuberculosis, typhoid, paratyphoid, bacillary dysentery, glanders, and leprosy are all bacilli. The bacilli of anthrax often arrange themselves in chains, called *streptobacilli*.

Besides the round and the rod-shaped germs there is still another group, composed of those having a spiral or corkscrew shape. These are collectively known as *spirilla* (singular, *spirillum*). The germ of Asiatic cholera belongs to this group.

CHAPTER TWO

THE FORTY[1] NOTIFIABLE DISEASES

IN the table on page 11 the forty notifiable diseases which we are to study in detail are arranged in the order of the number of deaths caused by each in the Registration Area of the United States in 1917, paralleled with the number of deaths from the same diseases in the great epidemic year of 1918.

The *Death Registration Area* of the United States (exclusive of Hawaii) consists of 34 states, the District of Columbia, and 16 cities in the non-registration states. The 14 states *not* in the Registration Area are:

Alabama	Iowa	South Dakota
Arizona	Nevada	Texas
Arkansas	New Mexico	West Virginia
Georgia	North Dakota	Wyoming
Idaho	Oklahoma	

A state or city is admitted to the Registration Area whenever it makes provision for reporting accurately 90 per cent or more of all deaths occurring within its bounds.

The *Birth Registration Area* is not quite so large as the Registration Area for deaths, and includes only those states (not cities) that are reporting 90 per cent of all births occurring within their bounds. In 1919 it consisted of 22 states and the District of Columbia, as follows:

[1] "Forty" is not to be taken literally. The actual number of notifiable diseases varies from state to state. Besides, this does not include industrial diseases that are, in many states, notifiable.

California	Massachusetts	Pennsylvania
Connecticut	Michigan	South Carolina
District of Columbia	Minnesota	Utah
Indiana	New Hampshire	Vermont
Kansas	New York	Virginia
Kentucky	North Carolina	Washington
Maine	Ohio	Wisconsin
Maryland	Oregon	

This area embraces 58.6 per cent of the estimated population of the United States.

TABLE 1

Disease	DEATHS 1917	DEATHS 1918
Tuberculosis (all forms)	110,144	121,204
Pneumonia	74,517	167,703
Cancer	61,429	65,282
Influenza	12,965	234,290
Diphtheria (together with croup and septic sore throat)	12,442	11,183
Measles	10,442	8,223
Typhoid (including also paratyphoid)	10,089	10,167
Whooping-cough	7,837	13,728
Syphilis	7,795	7,522
Meningitis	6,673	7,500
Dysentery (amebic, bacillary, and others)	4,546	4,720
Pellagra	3,666	3,711
Scarlet fever	3,124	2,335
Malaria	2,385	2,534
Tetanus (lockjaw)	1,329	1,276
Encephalitis	620	687
Gonorrhea	595	500
Cholera nostras	242	299
Smallpox	204	248
Rabies (hydrophobia)	66	63
Anthrax	61	34
Mycoses (actinomycosis and others)	39	46
Hookworm disease	29	28
Leprosy	17	24
Typhus	16	3
Glanders	4	4
Chancroid (not fatal)	0	0
Chicken pox (not fatal)	0	0
Asiatic cholera (no cases)	0	0
Dengue (not fatal)	0	0
Favus (not fatal)	0	0
German measles (not fatal)	0	0
Bubonic plague (no cases)	0	0
Poliomyelitis (infantile paralysis) (sometimes fatal)	0	0
Rocky Mountain spotted fever (sometimes fatal)	0	0
Trachoma (not fatal)	0	0
Trichinosis (rarely fatal)	0	0
Yellow fever (no cases)	0	0
Mumps (not fatal)	0	0

CHAPTER THREE

Forty Notifiable Diseases Classified According to Cause

In the table below the forty notifiable diseases have been arranged in convenient form for ready reference and comparison as to their general causes.

Table 2

	Known Vegetable Germ	Known Animal Germ	Germ Not Known	Filterable "Virus"[1]
1. Actinomycosis	X			
2. Anthrax	X			
3. Cancer[2]	—	—	—	—
4. Chancroid			X	
5. Chicken pox			X	
6. Cholera				
Asiatic	X			
Nostras			X	
7. Continued fever (not a disease entity)				
8. Dengue			X	X
9. Diphtheria	X			
10. Dysentery				
Amebic		X		
Bacillary	X			
11. Encephalitis (lethargic)			X	
12. Favus	X			
13. German measles			X	
14. Glanders	X			
15. Gonorrhea	X			

[1] See page 47. [2] Presumably not caused by germs.

TABLE 2 (Continued)

	Known Vegetable Germ	Known Animal Germ	Germ Not Known	Filterable "Virus"[1]
16. Hookworms		X		
17. Influenza	X			
18. Leprosy	X			
19. Malaria		X		
20. Measles				X
21. Meningitis (cerebrospinal fever)	X			
22. Mumps	?			
23. Paratyphoid	X			
24. Pellagra[2]	—	—	—	—
25. Plague	X			
26. Pneumonia	X			
27. Poliomyelitis	X			X
28. Rabies			X	X
29. Rocky Mountain spotted fever			X	
30. Scarlet fever			X	?
31. Smallpox			X	X
32. Syphilis		X		
33. Tetanus	X			
34. Trachoma			X	X
35. Trichinosis		X		
36. Tuberculosis	X			
37. Typhoid	X			
38. Typhus			X	
39. Whooping-cough	X?		?	
40. Yellow fever		X		X

[1] See page 47. [2] Presumably not caused by germs.

CHAPTER FOUR

Children's Diseases

Chicken pox	*Scarlet fever*
German measles	*Whooping-cough*[1]
Measles	*Smallpox*

Five of the six foregoing diseases are commonly known as children's diseases, but smallpox has so many points in common with the others that it is included.

Chicken pox and German measles rarely, if ever, cause a death and would not be included among the notifiable diseases but for the reason that through mistaken diagnosis epidemics of smallpox and measles may get started.

Measles, scarlet fever, and whooping-cough are really serious diseases among children. By reference to Table 1 it will be seen that in 1917 in the Registration Area measles caused over 10,000 deaths, while whooping-cough caused over 7000 and scarlet fever over 3000.

Children should never be rushed into these diseases to get them and "have it over."

Smallpox, although it has been in the history of the world a great scourge, has been "vaccinated to death," so that at present it is of little consequence, causing only one fiftieth as many deaths as measles.

[1] In 1906 Bordet and Gengou isolated what they thought was the germ of whooping-cough, but their claims have not been universally accepted. On the theory that this germ is the cause of whooping-cough, a corresponding vaccine against the disease has been placed on the market, but it cannot be said to be beyond the experimental stage.

The members of this group have many points in common: they are all contagious; the cause of each is unknown; all date to a definite exposure, followed by an incubation period, and then a rather sudden onset (except in the case of whooping-cough, which begins more gradually); all cause more or less rise of temperature and a quickening of the pulse; all are self-limited (that is, the patients get well or die, as the case may be, within a fairly definite period); all leave the individual immune; all have an eruption, except whooping-cough; and all are managed alike, except smallpox, which, being the one member of the group against which we can vaccinate, is in consequence the one member that is most perfectly controllable.

It has been customary time out of mind to try to control these diseases by quarantine, but so many mild cases occur, that are never reported to the health authorities and accordingly escape quarantine restrictions, that quarantine methods are only in part effective. Smallpox can be effectively controlled by vaccination of those exposed or likely to be exposed.

CHAPTER FIVE

Sewage Diseases

Typhoid fever[1]	*Bacillary dysentery*
Paratyphoid fever	*Amebic dysentery*
Asiatic cholera	*Hookworm disease*

The first four of these six diseases — typhoid fever, paratyphoid fever, Asiatic cholera, and bacillary dysentery — are due to well-known vegetable germs; of the last two, one — amebic dysentery — is caused by a minute animal organism, the ameba, and the other by a worm, the hookworm.

These six diseases have three important points in common: (1) they are all due to living organisms; (2) the chief locus of the trouble is in the intestinal tract; and (3) the chief desideratum in all is their prevention through proper sewage disposal.

In studying this group of diseases the first thing to determine is how the germs get from the alimentary tract of the sick to the alimentary tract of the well and thereby spread the disease. In amebic dysentery, which will be considered first, the way is not devious, but very direct. The amebæ (little animals too small to be seen with the naked eye) are excreted in the stools. A person with amebic dysentery is giving them off literally by the millions. Now whenever these amebic stools find their way into drinking-water and are swallowed, the deed is accomplished. This seems to be the only way amebic dysentery is ordinarily spread. It is not spread by

[1] Entirely different from typhus fever.

flies as is the typhoid germ or that of bacillary dysentery; and ordinarily it has no way of contaminating milk. One can imagine it contaminating oysters and running the gantlet that way.

An epidemic of one of these diseases that once occurred at Tampa, Florida, was caused in an unusual manner. The vegetable gardens at Ybor City, a suburb of Tampa, were flooded during the heavy rains. Soon after the rains subsided, lettuce came into the market (lettuce, it will be remembered, is usually eaten raw). Following this incident there occurred in Tampa an epidemic of typhoid fever and a considerable increase of amebic dysentery. However, accidents of this kind are rare, and in public health practice it is customary to consider any appreciable increase in the prevalence of amebic dysentery as proof of sewage contamination of the community drinking-water.

The amebæ of dysentery leave the body of the sick person only in the stools; but the germs of some of the other diseases (e.g., of typhoid and paratyphoid), besides leaving it in the stools sometimes leave it in the urine also, and occasionally they escape in the saliva (as in typhoid, for example). This multiplies opportunities for spreading these diseases. Indeed, the chances of infection through contaminated drinking-water are so great that sometimes we have great water-borne epidemics, particularly of Asiatic cholera; whereas the prevalence of amebic dysentery can hardly ever be said to reach epidemic proportions. Then there are other ways

of spreading these diseases. A person in attendance upon a case of typhoid fever, say, will get the infection on his hands. Soon the hands go to the mouth and some of the germs are left there. This method of transmitting the disease is known as *finger infection.* Finger infection is common where the patient is cared for by untrained help. Sometimes, even now, typhoid fever goes nearly through a family by finger infection.

But finger infection is only one way by which the typhoid bacilli get from the intestine of the sick to the intestine of the well. There are other ways. Suppose the stools from one of these patients are thrown out in the open. Flies are soon attracted to them. The flies feed on them, at the same time walking over them and getting the germs on their feet. Then they fly to the house, into the dining room, and walk over the food. If we had eyes a thousand times as fine as we have, we could see, wherever a fly walks after coming from one of these open privies, a trail of germs like mud tracks on a clean floor. An experimenter once let a fly walk across a plate of sterile gelatin. The germs that it left in its tracks grew and multiplied, and by the next day they were so numerous that they could be seen with the naked eye. There were little masses of germs wherever the fly had put its foot down. When flies carry the germs from typhoid stools to food, the method of transmission is called *fly infection.*

Again, when a person gets well from typhoid, he

may still excrete the germs for weeks or months, or even years afterward. In this case he is known as a *typhoid carrier.* Typhoid carriers spread the germs in their wake and are often the means of spreading the disease. This is particularly true when the carrier happens to be engaged as a milker or cook.

There was once a famous typhoid carrier in New York, known as "Typhoid Mary." She was a cook, and wherever she took service the family sooner or later developed typhoid fever. Sixty-seven cases of the disease were traced to this one cook.

You have doubtless heard of typhoid from milk. About the only way we get typhoid from milk is through the agency of a typhoid carrier engaged as a milker. A number of epidemics have been traced to this cause. But today in well-managed dairies all milkers are examined to make sure that they are not typhoid carriers.

Now all that has been said about typhoid may be said also, with perhaps a little less emphasis, about paratyphoid, Asiatic cholera, and bacillary dysentery.

This disposes, then, of five of the six sewage diseases. It has been seen that the amebæ leave the body only in the stools, and that they find their way into the bodies of others only through contaminated drinking-water. The germs of typhoid, paratyphoid, Asiatic cholera, and bacillary dysentery leave the body through the stools, and sometimes, as in typhoid, through the urine and saliva. They find their way to the mouths of others not only

through drinking-water, but by fingers, flies, and food (milk in particular). It now remains to see how the hookworms get from one person to another.

Unlike the amebæ and the typhoid germs, the hookworms do not leave the human body to get to other people; they just send their eggs. The worms remain in the intestine, feeding and laying eggs. Now the eggs — and this is an important point — *do not hatch in the intestine.* They must pass out in the stools and get to the air before hatching will take place. When a child has hookworms, his stools are loaded with eggs. These eggs are too small to be seen with the naked eye, but they can be seen under a microscope and in that way the doctor can determine if a child has hookworms — by finding the eggs. Let us follow these eggs after they have passed out in the stools. If the stools are passed into a sewer, the eggs go out into the river, or wherever the sewer empties, and are devoured by the tiny animals that together with tiny plants go to make up the *plankton;* or if they are not thus destroyed, they disintegrate — they never hatch.

On the other hand, suppose the stools are deposited on the ground in a shady damp place, as along a watercourse. Here they find ideal conditions and soon hatch. These eggs, bear in mind, are so small that it takes a microscope to see them; and the worm that hatches out is also microscopic in size. They can live in this damp soil for a long time. They even grow a little and moult, and then look as if they were going to moult again; that is, they seem

to get loose from their outside skin, *but they stay inside of it*, so that they look like little wiggly capsules. In this condition they are ready for business.

Their business is to get into the intestine of a child.[1] They cannot go out and hunt a child, they just have to wait and chance one coming along. Myriads of them die while waiting. But occasionally the child comes along and they make connection. He must be barefoot or have holes in his shoes, for the little worms cannot get through leather. But let us suppose that one of these worms has been able to come in contact with the child's bare foot. This worm, capsule and all, wiggles his way into the pores of the skin (the pores, it should be understood, do not go all the way through the skin). When the worm comes to the end of the little hole or pore which he has entered, he pushes through his capsule and goes right on through the remainder of the skin and on into the foot of the child. The capsule he leaves behind, *in the skin*. It is probably this capsule or outer skin of the young hookworm, left in the skin of the child, that causes the itching known as "ground itch." We shall not stop to discuss the ground itch now, but shall follow up the little worm's journey.

When he gets through the skin of the child's foot, he gets into the blood vessels. Here he finds himself in the blood stream, and traveling becomes easier.

[1] In this country children are the chief sufferers from hookworm disease, but adults are also susceptible and in some countries the disease is widespread among the adult population.

He is just carried along with the current of blood, and on he goes. This blood stream is very, very small at first, but gets larger as other vessels join it, and as it approaches the heart it is as large as one's little finger. After the worm has gone through the heart and has come out on the other side, he goes straight toward the lungs. Then the vessels get smaller and smaller, and about the time he gets to the lungs he is so cramped that he cannot go any farther and cannot even turn over in the little blood vessel. He is now in the capillaries of the lungs. These little capillaries have such thin walls that the oxygen we breathe just goes through the capillary walls into the blood, and the carbon dioxid goes through the same thin walls the other way to be thrown off. The little worm is now at one of the most interesting places in the body. If he could only understand things at this juncture! Thousands of millions of little red blood corpuscles are all around him, each acting as if it were a thing alive, and busy laying off its cargo of carbon dioxid and taking on a cargo of oxygen for remote parts of the body. But the little worm does not tarry here long. There is nothing between him and the outside air in the lungs but the thin membrane, and he soon breaks through that and finds himself in the air spaces of the lungs.

In the lungs the little worm is a foreign body, and a foreign body in the lungs causes coughing. So the child coughs; gradually the worm is raised till he gets to the throat and is swallowed. Now he

goes straight into the stomach, and then on through it, into the intestine. How he gets through the stomach without being digested like any other tiny piece of meat is more than I can tell, but he seems to do it — at any rate he finally stops in the intestine, where he attaches himself to the lining and begins to suck like a baby possum. You know that when a possum is born, it is very, very small. Its mother puts it into the pouch and attaches its mouth to a little nipple found there. The little possum remains attached to that nipple through thick and thin, sucking when hungry, and growing and growing until it is too large for the pouch. That is the very way the baby hookworm does. You should know that in the intestines are thousands of little nipples called *villi*. The baby hookworm seizes a group of these and goes to sucking; but he does not get milk —he gets blood. On this food the young hookworms grow until they are full-grown hookworms.

That is the life history, or the circuit, of the hookworm. It begins in the intestine of one child and ends in that of another. It takes about six weeks from the time the child has ground itch until the young worms reach the intestine, grow up, and begin to lay eggs themselves.

The ground-itch route is the chief method of spread of hookworm infection, but it has been shown that young hookworms may live for some time on vegetables, and it seems certain that the infection may be acquired through eating such infected vegetables raw. This would explain how it is that

adults, whose feet are protected by shoes, sometimes become infected.

This completes our discussion of the sewage-borne diseases. Summing up: first, we have amebic dysentery, strictly water-borne; next, the vegetable group — composed of typhoid, paratyphoid, Asiatic cholera, and bacillary dysentery — which are transmitted through water, and also by flies, fingers, and food; and last, the hookworm, which generally travels by the ground-itch route, less commonly by infected vegetables. From these facts it is clear that every one of these six diseases would disappear from the face of the earth if all sewage were properly disposed of. Perhaps the world's greatest sanitary problem today is the disposal of human excrement. Victor Heiser has estimated that even today there are 100 million people in the world perennially sick from improper methods of sewage disposal, although its dangers have been known since the time of Moses, some thousands of years ago.

CHAPTER SIX

Diseases Spread by Suctorial Insects

Dengue	*Plague*
Malaria	*Typhus fever*
Yellow fever	*Rocky Mountain spotted fever*

Of the forty diseases under discussion, parasites of six (those listed above) manage to get from host to host through the aid of other parasites. Each of these disease-producing pairs of parasites has a system of teamwork which is hard to break up. The parasites causing dengue, malaria, and yellow fever have mosquitoes as partners in their iniquity; the parasite causing plague is carried from rat to rat and from rat to man by fleas; the typhus-fever parasite is a "buddy" of the head and body lice; and the parasites of the Rocky Mountain spotted fever chum with the lowly tick.

The malarial parasites were discovered about forty years ago. They are now so well known that they have even been separated into different species, at least three of which are recognized by biologists. The plague parasite has been known since 1894, but the yellow-fever parasite was not discovered until three years ago. The germs of the remaining three — dengue, typhus fever, and Rocky Mountain spotted fever — are still in hiding, although the Typhus Research Commission of the League of Red Cross Societies to Poland reports substantial progress in investigating the cause of typhus.[1]

[1] See *Journal of the American Medical Association*, page 1054, April 8, 1922.

The parasite of plague is a vegetable organism, a bacillus; the parasite of malaria is an animal organism; and the parasite of yellow fever, according to its discoverer, Noguchi, may be described as "betwixt and between" a vegetable and an animal. The parasites of dengue, typhus fever, and Rocky Mountain spotted fever are, as above indicated, unknown.

The malarial parasites are transmitted by mosquitoes of the genus *Anopheles;* and both the yellow fever and the dengue parasites are transmitted by the species of mosquito known as *Ædes calopus.* There are some 50 different species of *Anopheles* known. However, not all of them transmit malaria. The *Ædes calopus* is the same mosquito that we used to call the *Stegomyia calopus*, and before that we called him[1] the *Stegomyia fasciata*, and still before that, at the time Walter Reed caught him red-handed in the act of transmitting yellow fever, he was the *Culex fasciata.* In fact, if you were to chase him back through all his names, you would find he has been christened no fewer than seventeen or eighteen times. Such a wholesale renaming process usually comes about through the fact that from time to time different persons in different parts of the world describe and name a species, and later it is found that these names all mean the same thing; then, by agreement, the oldest name sticks.

Considering the malarial parasite a little more in detail, it will be noted that the mosquito is host

[1] In personifying the mosquito, the masculine pronoun is used here, although it should be understood that it is really the female that actually transmits the disease; the male never bites a person.

for this parasite, and that the human being is host for both the malarial parasite and the mosquito.

The malarial parasite reproduces in the blood of the human being; it also reproduces in the body of the mosquito. In the human being it reproduces without sex, but in the mosquito there is a mating process; that is, the reproduction is sexual. The host in which sexual reproduction takes place is known as the *definitive* host, and the one in which non-sexual reproduction takes place is known as the *intermediate* host. Accordingly, the human being is the intermediate host and the mosquito the definitive host for the malarial parasite.

In theory it is possible to control any of these team-work diseases by breaking up the team; that is, by controlling either member of it — the malarial parasite or the mosquito; the plague bacillus, the rat, or the flea; the typhus germ or the louse.

In practice we sometimes attack in one place and sometimes in another. We may try to break up the germ-mosquito combination by killing the germ or by killing the mosquito. When we try to control malaria by the broadcast use of quinine, as is being done in an experiment in Sunflower County, Mississippi, we are making our attack on the germ. When we try to control it by drainage or oiling, we are attacking the mosquito.

In combating plague, it has been found most practicable to attack the germ-flea-rat combine by killing the rat. That is why an anti-plague campaign consists of rat killing.

In typhus fever, the germ-louse combine is broken up by killing the louse — "delousing," as the process is called.

In dengue and yellow fever the attack is made on the mosquito.

Rocky Mountain spotted fever, as above indicated, is transmitted by the tick,[1] *Dermacentor andersoni*.

Back in 1906 Ricketts discovered how this fever is transmitted. Not only adult ticks, both male and female, but also larvæ and nymphs, are capable of transmitting the disease, and the eggs from infected ticks in turn hatch out infected larvæ.

The natural reservoir of the infection seems to be the wild animals in the region where the fever occurs. Ticks feeding on these get the infection and transmit it to man. The great mass of ticks unquestionably become engorged on domestic animals, and this suggests dipping and spraying as means of tick control. Sheep grazing diminishes the number of ticks, "for the reason that ticks die upon sheep, and many of the engorged females are not fertilized on account of the difficulty experienced by the males in propelling themselves through the thick wool in search of the females. This method has been successfully tried in controlling the ticks and the disease in the Bitter Root Valley in 1914."

[1] Although the tick is not a true insect, it is classed with the other true insects that are involved in this group of diseases.

CHAPTER SEVEN

The Venereal Diseases

Chancroid Gonorrhea Syphilis

The principal facts to be learned in connection with these diseases may perhaps be best studied by referring to the table on the following page.

One of the greatest difficulties in trying to check the spread of venereal diseases is that in many instances the patient, believing he has fully recovered, is still a carrier of the germs. A person having gonorrhea, for example, may apparently get well, while still harboring the germs. In this condition, though seemingly well himself, he can transmit the infection to others. Thus wives sometimes become infected from husbands who have supposed themselves recovered from the disease.

In connection with these facts it may be said here that one of the greatest causes of the spread of disease may be found in the fact that many persons, directly or indirectly, transmit a disease without realizing it. The disease-spreading Typhoid Mary (page 19) well illustrates this point. It occasionally happens that such unwitting spread of disease brings about civil action on the part of the victim. An interesting example of this sort occurred a few years ago. A man sued one of our largest railroads for $10,000 damages. He and his family had contracted smallpox from a section gang on the railroad, and the railroad, it was held, was liable for damages, by allowing the disease to be transmitted.

TABLE 3

	CHANCROID	GONORRHEA	SYPHILIS
Acquired by sexual contact	X	X	X
Occasionally by accident		X	X
Never hereditary	X	X	X
May be acquired from either parent at time of conception			X
May be acquired from mother at any time during gestation			X
May be acquired from mother at time of delivery [1]		X	
Local (limited, usually to genitalia)	X		
General			X
Begins local but may reach remote parts, as bladder, ureters, kidneys, seminal vesicles, testes, or even joints, causing what is known as "gonorrheal rheumatism"		X	
Causing acute pain	X	X	
Causing much blindness		X	
Causing many operations on women		X	
Causing insanity			X
Causing most sterility in both sexes		X	
Causing most stillbirths			X
Causing most varied symptoms, as eruptions, nervous manifestations			X
Most prevalent		X	
Relative prevalence in the United States	2	6	1
Always curable but more or less disfiguration	X		
Curable when taken in hand early (?)		X	X
Occasionally totally refractory to treatment		X	X
Apparently cured, really cured	X		
Apparently cured, yet more or less doubtful for a long time		X	X
Treatment by cauterization	X		
Treatment by general measures and antiseptics		X	
Treatment by general measures, mercury, and salvarsan (606)			X

[1] In this case it develops in the eyes of the infant and is known as *ophthalmia neonatorum*. Much blindness is directly due to this cause, but such blindness could be easily prevented by dropping 1 per cent solution of silver nitrate in the eyes of the new-born child.

He who transmits a venereal disease, however, inflicts a far greater damage than the railroad did, and in many cases he does it (or rather takes the chance) knowingly, whereas the railroad did this unwittingly. Would not the transmission of venereal disease be cause for civil action? Will the transmission of venereal disease ever be cause for criminal action?

Early in 1922 a bill was introduced into the Reichstag providing, among other things, that "any one who knows, or to judge from his condition must assume, that he is suffering from an infectious sexual disease, and who, in spite of the fact, exposes another in the customary manner to the danger of infection, is subject to imprisonment."

CHAPTER EIGHT

Diseases Affecting Especially the Nervous System

Cerebrospinal meningitis
Poliomyelitis (infantile paralysis)
Rabies
Tetanus
Encephalitis

These five diseases affect especially the brain and spinal cord. Of the five, rabies, tetanus, and encephalitis are considered elsewhere (see Glossary); cerebrospinal meningitis and infantile paralysis will be discussed briefly in this chapter.

The germ that causes cerebrospinal meningitis has been known a long time, but the one that causes infantile paralysis has only lately been isolated by Flexner and Noguchi of the Rockefeller Institute, New York.

Cerebrospinal meningitis (cerebrospinal fever, or "spotted fever," if you choose) is an epidemic disease of some importance, causing about six or seven thousand deaths a year. In addition to the deaths that it causes, a large number of the victims are left permanent cripples of one kind or another.

The epidemic behavior of the disease is rather peculiar,[1] and in this respect there is only one other disease — infantile paralysis — like it. In 1904 an outbreak occurred in Madison, Florida, which illus-

[1] The explanation that is offered for such erratic behavior is that there is a large number of carriers among the well, and that of those exposed, only a very few ever contract the disease. Although admittedly lame, this is the best explanation we have to offer at the present time.

trates this behavior. Suddenly, like a bolt from a clear sky, a case of the disease appeared, and then another, and another; then a death occurred, and another, and another. Excitement ran high. In all there were 30 cases diagnosed, and 7 deaths.

Now, one of the notable facts concerning this outbreak is that in only two instances did more than one case occur in a family, or indeed in the same household; and in one of these two instances both cases appeared on the same day. This is not an uncommon phenomenon in the epidemic behavior of both cerebrospinal fever and infantile paralysis.

Another notable phase of the outbreak is that the epidemic rose like a tide and then subsided, leaving nothing to show that it had been there except the deaths and the fact that one of the individuals who recovered was afterward cross-eyed.

Another fact to be noted is that while this outbreak was going on in Madison, there was, 6 miles away in the country, a little girl who had the disease, although she had not been to Madison for half a year; also, there was another case 12 miles in another direction; there were two more over 100 miles away in Columbia County; and about 200 miles away in Marion County there was still another one. But the center of the storm was at Madison.

Now, in a general way, this is what happens in most outbreaks of meningitis. There is a center where the disease reaches its maximum of intensity; but sprinkled round at varying distances and with no seeming connection there are a few other cases.

Infantile paralysis behaves in the same way. We may go for years without a case; then without warning there is an outbreak. There is always a focus more intense than elsewhere, and radiating out from that focus other cases are encountered in varying numbers.

Infantile paralysis does not cause so many deaths as it does permanent cripples. Certain nerves in the spinal cord become paralyzed, and then the muscles presided over by these nerves become paralyzed. The disease often comes on suddenly. A child may be quite well, to all appearances, and then perhaps miss a meal and possibly have a little fever for a day or so; then it is soon noticed that the child does not use, say, a foot, or leg, or arm — so insidious is the disease.

CHAPTER NINE

Diseases Contracted from Lower Animals

Actinomycosis	*Rabies*
Anthrax	*Rocky Mountain spotted fever*
Glanders	*Trichinosis*
Plague	

Of these seven diseases, only rabies will be considered here. Information regarding the other six diseases, and also additional information on rabies, may be had by referring to the Glossary.

Rabies, or *hydrophobia*, is a disease to which probably all warm-blooded animals are susceptible. Dogs chiefly get it, but less often cats, cows, horses, and other domestic animals. It sometimes gets started among wild animals, as wolves, and plays havoc with them.

The germ causing the disease is not known, but it is known that the brain and spinal cord are the parts chiefly attacked. An Italian by the name of Negri found in the brain and spinal cord of animals affected with rabies certain little bodies, since known as "Negri bodies." These we know are connected in some way with rabies; indeed, they may be the germs themselves. They have been found in the brain, spinal cord, and saliva of animals affected with rabies, but nowhere else. The disease is transmitted through the bite of an infected animal.

When a dog's head is sent to the laboratory to be examined for rabies, it is these little "Negri bodies" that are hunted out. If the bacteriologist

finds them, he reports back that the animal had rabies. But sometimes he cannot find them; then he does not know whether the animal had rabies or not, for it should be understood that these Negri bodies are very scarce the first day or so after the disease develops. The bacteriologist might hunt for hours and hours and still not find them. But as the disease progresses in the animal, the bodies become more and more abundant, and by the time death takes place they are usually numerous and easy to find.

Thus it is apparent that *if the bacteriologist fails to find the Negri bodies, he cannot pronounce the animal free from the disease.*

The practical lesson to be learned from these facts is that when an animal is suspected of having rabies, *do not kill him*, but shut him up and wait. He is your best witness. If you kill your witness and then the laboratory fails to find the Negri bodies, you will never know whether the animal was mad or not. Shut him up instead, and if he has rabies he will get rapidly worse and will die in 4 or 5 days with unmistakable symptoms. You will then know what you are dealing with.

CHAPTER TEN

Diseases Having a Well-defined Geographical Limitation

Malaria   Hookworms   Rocky Mountain spotted fever

If you were to draw a line through a map of the United States from top to bottom at about the middle of the map, and then another line from right to left at about the middle, the area would be blocked out in four quadrants — northeast, southeast, northwest, and southwest. The southeast quadrant is the area of endemic malaria in the United States. Except for a little territory in New York and New Jersey, and another small area in California, malaria is limited to the southeast quadrant. Why? Why is it not found in Maine, or Minnesota, or Colorado? The answer is not far to seek. In Maine there is enough rain, but it is too cold. In Minnesota there is also rain, but it likewise is cold. In Colorado it is warm enough, but there is not much rain.

Two conditions for malaria are required: *water in which mosquitoes can breed* and a *reasonable warmth.* In the southeast quadrant those conditions are fulfilled. It is the one quarter of the United States that has an abundance of both warmth and moisture. In the Sacramento and San Joaquin valleys there is enough moisture to provide a mosquito fauna, and, as is to be expected, there is malaria.

Centering around New York and New Jersey is an area more or less famous for mosquitoes. One would naturally expect an area of malaria there.

Regarding this area, the United States Public Health Service says: "Of the two smaller endemic areas (of malaria), one includes a section of the northern part of New Jersey, southeastern New York, Connecticut, Rhode Island, and part of the state of Massachusetts."

The hookworm is even more sensitive to environmental conditions than the malarial mosquito, and is a little more restricted in habitat. Like malaria, the hookworm occupies the southeast quadrant of the United States, and like malaria it has a little patch in California where warmth and moisture prevail. But unlike malaria it has no foothold in New York and New Jersey. The two conditions required for malaria are even more necessary for the propagation of hookworms.

Such is the distribution of hookworms in the United States. If you want a clear picture of their distribution over the whole world, just imagine a globe with the torrid zone widened out from 47 degrees to 80 degrees, and you will have the potential habitat of this parasite. It is true that in this zone there are great stretches of desert where the hookworm could not exist. Even the highly porous soil of portions of southern Florida dries out so quickly that the hookworm cannot survive. In this great belt there are also mountains that have a mean temperature entirely too low for the hookworms; but in a general way, taking into consideration the exceptions noted, this belt represents the hookworm zone of the world.

The third and last of the forty notifiable diseases that have a geographical limitation is Rocky Mountain spotted fever. This disease prevails in the bitter Root Valley of Montana, and to a less extent in the neighboring states of Idaho, Wyoming, California, and Washington.

It will be recalled that it is transmitted by ticks, of the species *Dermacentor andersoni*. These ticks infest both the wild and the domesticated animals in this region, and occasionally they get the infection from some of these animals and in turn may transmit it to man. The parasite itself is unknown.

Maver has shown by experiment that other kinds of ticks may also become carriers of the disease. He found that ticks collected in three widely separated states — Utah, Missouri, and Massachusetts — were capable of transmitting the infection. There is, therefore, no apparent reason why the parasite should occupy such a limited area as it does at present. In time it may come to occupy a larger one — no one can say.

CHAPTER ELEVEN

Diseases of Unknown Causation

Cancer *Pellagra*

Besides cancer and pellagra there are many other diseases, the cause of which is unknown. We do not know, for example, the cause of measles, whooping-cough, or smallpox; but although the germ causing these diseases is unknown, we are nevertheless sure that they are germ diseases. On the other hand, cancer is not even suspected of being caused by a germ; pellagra is thought to be of dietary origin, but there is no certainty about the cause of either of them.

As cancer is by far the more important of the two diseases listed at the head of this chapter, we shall devote most of our time to a consideration of it. A few facts concerning the disease may be learned by referring to page 65.

Cancer is a much more important disease than the majority of people generally think it to be. A comparison with some of the other diseases will show its importance. Turning to the table on page 11 listing the forty notifiable diseases in the order of the number of deaths that they cause, we note that the four leading causes in 1917 were tuberculosis, pneumonia, cancer, and influenza. It will be observed that the first three diseases cause 60,000 deaths, or over, in a year; and then for the fourth disease there is a sudden drop to one fifth that number. Cancer accordingly stands third highest among these causes of deaths.

It has been found that the number of deaths from cancer is increasing. The number of deaths from pneumonia is also increasing, but at a less rapid rate. Thus, if the present rate keeps up, within a measurable time cancer will take its place as the leading cause of death in the United States.

Women are affected much more than men. It is easy to remember that the death rate from cancer among women is 1½ times that among men.

Cancer is essentially a disease of advancing years. Over ten times as many cases occur above the age of 45 as below it.

What every one wants to know is whether cancer is hereditary, or as the laymen are learning to frame the question now, whether a "predisposition to cancer" is hereditary. The subject has been investigated by the Medico-Actuarial Committee, and their findings are of interest. The Committee studied a group of persons with a history of two or more cases of cancer in the family. The expected death rate in this group was 87.3. The actual death rate proved to be only 69, and of these only 4 were from cancer.

In 1914 there was formed in New York City the American Society for the Control of Cancer. Dr. Frederick L. Hoffman, of the Prudential Insurance Company of America, is and has been a leading spirit in that organization. The Society has issued a leaflet under the caption, "Vital Facts about Cancer." The following excerpts are from that leaflet:

"During the Great War the United States lost about 80,000 soldiers. During the same two years 180,000 people died of cancer in this country. Cancer is now killing one out of every ten persons over 40 years of age.

"Many of these deaths are preventable, since cancer is frequently curable, if recognized and properly treated in its early stages.

"Cancer begins as a small local growth which can often be entirely removed by competent surgical treatment, or, in certain external forms, by using radium, the X-ray, or other methods.

"Cancer is not a constitutional or 'blood' disease; there should be no thought of disgrace or of 'hereditary taint' about it.

"*Cancer is not a communicable disease.* It is not possible to 'catch' cancer from one who has it.

"*Cancer is not inherited.* It is not certain even that a tendency to the disease is inherited. Cancer is so frequent that simply by the law of chance there may be many cases in some families, and this gives rise to much needless worry about inheriting the disease.

"The beginning of cancer is usually *painless;* for this reason its insidious onset is frequently overlooked and is too easily neglected. Other danger signals must be recognized and competent medical advice obtained at once."

Then the authors enumerate some of the signals:

Lump in the breast. "Every persistent lump in the breast is a warning sign. All such lumps are

by no means cancer, but even innocent tumors of the breast may turn into cancer if neglected."

Discharge or bleeding. "In women, continued unusual discharge or bleeding requires the immediate advice of a competent doctor. The normal change of life is not accompanied by increasing flowing, which is always suspicious. . . ."

Sore that does not heal. "Any sore that does not heal, particularly about the mouth, lips, or tongue, is a danger signal. Picking or irritating such sores, cracks, ulcerations, etc., or by treating these skin conditions with home remedies, pastes, poultices, caustics, etc., is playing with fire. Warty growths, moles, or other birthmarks, especially those subject to constant irritation, should be attended to immediately if they change in color or appearance or start to grow."

Indigestion. "Persistent indigestion in middle life, with loss of weight and change of color, or with pain, vomiting, or diarrhea, call for thorough and competent medical advice as to the possibility of internal cancer."

As to pellagra, there is not much to be said. Its exact cause is not known. Some theories about it may be mentioned.

The "spoiled maize" (cornbread) theory, first proposed by Lombroso, a great Italian scholar. This theory is now generally abandoned.

The "sandfly" theory, proposed by Sambon, an Englishman. Sambon thought the epidemiological evidence sufficient to convict the sandfly

of transmitting the disease. This theory also is now abandoned.

Other minor theories have been proposed, but we are not interested in them. *At present the prevailing opinion is that the disease has some connection with the diet. Certain it is that treatment addressed to correction of all errors of diet has been the most successful.* It is well to remember that pellagra has three groups of symptoms:

1. Nervous symptoms, which may consist of anything from hot or cold sensations on the one hand, to insanity at the other extreme.
2. Intestinal symptoms.
3. Eruption.

In a given case any of these symptoms may be partly or wholly suppressed.

CHAPTER TWELVE

Some Diseases Which May Be Spread by Carriers

Diphtheria	*Paratyphoid*
Gonorrhea	*Pneumonia*
Influenza	*Poliomyelitis*
Malaria	*Syphilis*
Meningitis	*Typhoid*

When a person gets well from a communicable disease, he usually gets rid of the germs causing it. This is particularly true in such diseases as measles, whooping-cough, and smallpox.

But in some other diseases this is not the case at all. In diphtheria, for example, the person may get well and still retain the germs; in other words, he becomes immune to the diphtheria germs, but the germs themselves continue to grow in his throat for weeks or months. Such persons are called "diphtheria carriers." Ehrlich, the great German investigator, used to speak of such cases as having "immunity without sterilization."

It should be understood that all cases of diphtheria do not terminate as carriers, but that quite a number do. Moreover, some persons become carriers of diphtheria without ever having had the disease, or at least without knowing that they had it. Such persons might have had a mild attack that went undetected, or may never have had it at all. Nevertheless, they are carriers and are capable of transmitting the disease to susceptible persons.

These facts apply with equal force to all the diseases at the head of this chapter. In each case a person may be a distributor of the infection after having had the disease in question, or he may be a distributor even though there is no history of his having had the disease.

CHAPTER THIRTEEN

Diseases Due to Filterable Viruses

Dengue	*Scarlet fever* (?)[1]
Measles	*Smallpox*
Poliomyelitis	*Trachoma*
Rabies	*Yellow fever*

The word "virus" does not have a very sharply defined meaning. It was formerly applied particularly to the germs of smallpox and cowpox. As long as the germ of a communicable disease is *unknown*, it is commonly referred to as the "virus."

A "filterable virus" is one that will go through a special filter, made of unglazed porcelain or diatomaceous earth, that filters out ordinary bacteria. There are several kinds of these special filters in the market, as the "Berkefeld" and the "Chamberland," of which the pores are so fine that while they will let liquid through, they will hold back all ordinary germs — one could almost say *all known germs.* Indeed, one could have said so until recently, but now that Noguchi has discovered the germ of yellow fever, and Flexner and Noguchi together have found the germ of poliomyelitis, exception has to be made of these two.

[1] Not only here, but generally throughout this book, the interrogation point implies a degree of doubt.

CHAPTER FOURTEEN

Nine Diseases Amenable to Immunization

Asiatic cholera	*Rabies*
Bubonic plague	*Smallpox*
Paratyphoid	*Diphtheria*
Typhoid	*Tetanus*
Anthrax	

It is quite possible to obtain immunity against several of the notifiable diseases. Of the nine listed above, a person can be immunized against the first four — Asiatic cholera, bubonic plague, paratyphoid, and typhoid — by the injection of a dead culture of the germs causing the disease; for the next three — anthrax, rabies, and smallpox — living attenuated organisms are used to obtain immunity; and for the last two — diphtheria and tetanus — an antitoxin is effective.

Immunity may be acquired against two of these diseases — Asiatic cholera and bubonic plague — in more than one way; namely, by the use of dead cultures and by the use of living attenuated organisms. But however they may be varied or combined, there are at bottom only the three methods above mentioned of producing artificial immunity.

The simplest method is by the injection of dead cultures of the germs causing the disease. But before going into that let me give you a theory that has been advanced. This is not accepting it or rejecting it, understand, but merely stating it. According to this theory, living germs of typhoid do not hurt one—it is only after they die and disin-

tegrate that the poison which causes the symptoms of the disease is set free. *When we have typhoid fever, it is not the living germs but the dead ones that make us sick.* Of the living germs in our bodies, some are multiplying, some are dying; but the living ones contribute to the disease only in furnishing more and more germs to die, while in turn the dead ones are the real cause of the trouble. And it is the dead ones that cause the immunity to develop.

According to this theory, then, when dead typhoid germs are injected into the body, the patient is virtually given a little slice of typhoid fever. These dead germs cause the immunizing substances to appear in the blood, after which the person is immune. For typhoid fever is like smallpox in that a person ordinarily has it only once.

The typhoid germs that are used in inoculating against the disease are grown in the laboratory, and then killed by heat and a small quantity injected into the individual. After a week to ten days a second dose is given, and then a third. Paratyphoid is prevented in the same way.

For Asiatic cholera there are two methods of immunization — one by the injection of dead germs, as in typhoid, and the other by the use of "attenuated" germs, similar to the method used in vaccinating against anthrax, which we shall discuss shortly.

For plague also there are two methods, with some additional variations. The first and chief method, known as *Haffkine's*, consists of injections of dead plague germs, just as dead typhoid germs are in-

jected to immunize against typhoid. A second method — that of giving attenuated germs — has also been used. The next paragraph will make clear the details of the method of giving attenuated germs.

When we turn to anthrax, rabies, and smallpox, we find that immunization is obtained by giving attenuated germs only. In this method the germs are alive, but before they are injected they must be weakened — "attenuated," as it is called. Now this method was not learned in a day. Indeed, it required a quarter of a century of study by scientific men to bring the idea to full fruition. Devaine and Rayer, Koch, Delafond, and Jaillard are some of the names that will be forever associated with the history of the anthrax germ. But to Louis Pasteur belongs the honor of having won a complete victory over it. Without going into the various experiments or steps, but merely stating the result, Pasteur found that he could attenuate anthrax germs by growing them in neutral chicken broth at a temperature of 42 or 43 degrees (centigrade) in the presence of air. Thus grown they would not form "spores"[1] and would gradually cease to grow and ultimately die; but

[1] "Spores" of germs correspond roughly to the seeds of higher plants. When spore-forming germs (all germs do not form spores), as the anthrax germs, for example, are grown under certain conditions, a tiny body develops in each germ, and then the rest of the germ disappears and only this little body — known as the *spore* — is left. It is very resistant to unfavorable conditions. It may remain dormant for years, and then when brought into favorable environments it will revive and begin to grow and reproduce. When Pasteur was working with anthrax it was known that certain pastures were rated as dangerous, for cattle that grazed upon them would sooner or later develop anthrax in the herd. It was customary at that

before the cultures were finally dead, they could be injected into susceptible animals and the disease produced in mild form. The animals thus treated were afterward found to be immune to virulent germs.

It is not customary to immunize human beings against anthrax, but of course it could be done.

As to rabies, the germ itself is not known and cannot therefore be grown in the laboratory; but Pasteur found that the virus is present in the brain and spinal cord of an animal affected with the disease. The way he proved this was by injecting a small portion of the brain or spinal cord of such an animal into a well animal (which we will call No. 2). For this experiment he used the rabbit by preference. He found that rabbit No. 2 would develop rabies in about 14 days. Then he found that he could inject a small bit of the cord of animal No. 2 into a third animal (No. 3) and this would produce rabies in just a little less time than in No. 2; No. 4, he found, would come down in still less time, and when he had passed it through about 50 rabbits, the incubation period was reduced to 6 days. But try as he would he could not reduce the incubation period below 6 days.

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time to bury all animals that died of anthrax. This measure was thought sufficient to rid the herd of the infection. But Pasteur found that above the graves of these buried animals he could isolate these spores from the soil, even years after the animals had been buried and crops had been grown over the grave. But how the spores could get up to the surface from the animal buried 3 to 6 feet deep was at first a mystery. Pasteur showed, however, that earthworms brought them up.

Now, let us see just what happened. By passing the virus through rabbits he increased its virulence; in other words, he made it stronger or, as the bacteriologists say, "exalted the virus." The more "exalted" the virus, the quicker it will produce death.

Having "exalted" the virus by passing it through rabbits, Pasteur undertook to "unscramble the eggs"; that is, to weaken the virus or *attenuate* it. This he succeeded in doing by a method of drying. He took the spinal cord of a rabbit that had died of rabies, and dried it 14 days; then he found that he could inject it into another rabbit and it would not produce rabies at all. The year before this, Pasteur had attenuated anthrax germs by *growing them in an unsuitable temperature.* Now, he had attenuated rabies virus *by drying.*

When Pasteur had attenuated anthrax germs, it was only another step to protecting an animal against anthrax. All he had to do was to inject a few of these attenuated germs, and the animal would have a very mild case of the disease — hardly get sick at all; and after that he would be immune to anthrax. But to produce immunity against rabies was not so simple. He knew the virus was safe when it had been dried 14 days. So he began by giving an animal an injection of cord that had been dried 2 weeks. Then the next day he gave an injection that had been dried only 13 days; the dose the next day had been dried 12 days; then 11, 10, 9, 8, and 7, and on down to a perfectly fresh cord that had not been

dried. But the rabbit showed no signs of the disease at all! And yet this last dose, you will remember, was a fresh cord that had not been dried — one that would ordinarily produce rabies in 6 days!

This was Pasteur's victory over rabies. He could immunize a person against this dread disease in about 3 weeks. Thus we have what is known today as the "Pasteur treatment." The scheme of injections has been changed somewhat — for instance, we do not begin with a 14-day cord — but the principle is unchanged. It is another method of producing immunity by the use of a living attenuated virus.

At the time these experiments of Pasteur's were being carried out (about 1875–80) persons had been vaccinated against smallpox for nearly 100 years, but nobody understood it. All that was known was that there was something between smallpox and cowpox, and that when one had cowpox he became immune to smallpox. Edward Jenner, who first vaccinated with cowpox to prevent smallpox, suspected that cowpox was a modified form of smallpox, but had no evidence to support it. Pasteur's work with anthrax and rabies gave support to the theory, but it was later experiments that brought forth the proof. It has now been shown that one can vaccinate a calf from a smallpox patient, and from that first calf vaccinate a second calf; from the second calf, a third, and so on until after a while a regular strain of vaccine will be produced. Here we have another example of *attenuation*, but in this case it is brought

about by passing the virus through the skin of the calf.

In actual practice, then, we have three methods of attenuation: for anthrax, by growing the germs at a high temperature; for rabies, by drying; and for smallpox, by passing through the skin of the calf. In each case we produce immunity by using the living organism, but in an attenuated form.

When we come to diphtheria and tetanus we find that immunization is brought about by the injection of *antitoxin.* This method is known as "passive immunization." To understand this, it is necessary to know something of the production of antitoxin.

Suppose we wanted to produce some diphtheria antitoxin. We should proceed in the following manner:

First, we should get some diphtheria germs. We could get these from the throat of any child having diphtheria. Next, we should plant these germs in suitable liquid in the laboratory, and they would increase in numbers until the liquid became a mass of diphtheria germs. Then we should filter the germs out by running the liquid through a fine strainer — so fine that the germs could not pass.

It would now be found that if this liquid were injected into a susceptible animal, it would cause symptoms of diphtheria. Let us see what really happens. While the diphtheria germs were growing in the liquid, they were throwing off the diphtheria poison, and this poison is still in the liquid. Now let us throw away the germs which we have filtered

out, for it is the poison thrown off while the diphtheria germs were growing that we are interested in. This poison is called *diphtheria toxin.* It is the same thing that the germs are throwing off while growing in the throat of a child ill with diphtheria, and it is the absorption of this toxin by the child that makes him sick.

Having now a supply of this diphtheria toxin, we first inject a little of it into a horse. It makes him slightly sick, but he soon recovers because the dose is small. When he gets well he is given another dose — a little larger this time. As soon as he recovers from this dose, he is given a third, and a fourth, and so on. He is injected now about twice a week for two or three months; the dose of toxin is made larger and larger with each injection, until finally he can take great quantities without being hurt by it. He is immune against diphtheria toxin.

Now it has been found that if this horse is bled and a little of his blood mixed with diphtheria toxin, the latter is destroyed. If the toxin thus treated is then injected into another horse or into some other animal, it produces no symptoms at all. The blood of the immune horse acts on the toxin as water acts on a fire — it "puts it out," so to speak. The blood of a horse that has not been injected with this toxin and immunized will not, of course, act in this way; it is only the blood of an immune horse that is effective. This shows that while the horse is being immunized a new something is being added

to his blood, something that will overcome the diphtheria toxin or poison.

This new ingredient, it has been found, is thoroughly mixed with the liquid portion of the blood, for the corpuscles can all be strained out and the serum will still overcome the diphtheria toxin. This new something has been given a name — it is called *antitoxin* because it is *against toxin* and overcomes it.

Now bear in mind that the toxin comes from the growing diphtheria germs, and this toxin is injected into a horse again and again until he is immune against it; that is, large quantities can be injected and it will not hurt him. Then in the blood of this immune horse we find *antitoxin*, the substance that will overcome the toxin.

The horse is now bled and his serum put up in bottles ready for use. Let us see when and how it is used. Suppose it is suspected that a child has diphtheria. The doctor takes a little "smear" from the child's throat and sends it to the laboratory. This specimen is examined under the microscope, and if diphtheria germs are found, it is known for a certainty that the child has diphtheria. It will be remembered that while the diphtheria germs are growing in the throat they are throwing off diphtheria toxin. It will be remembered also that we got the toxin to immunize the horse by growing these germs in a laboratory and then saving the resultant toxin. When they grow in the throat of a child, they throw off the toxin in the same way. The child absorbs the toxin and it makes him sick just as it

would if it were injected into him. If he absorbs very much of this toxin, it makes him very sick. At this juncture if you could destroy some of the toxin that the child is absorbing, he would not be so sick. Just here is where we have use for the antitoxin that was taken from the immune horse. We inject some of this antitoxin into the child; the antitoxin immediately overcomes some of the toxin and the child is better at once.

What has been said of diphtheria antitoxin applies also to tetanus antitoxin. To make the tetanus antitoxin, the tetanus germs are grown instead of the diphtheria germs; otherwise the two processes are identical.

Bear in mind, however, that when the horse is immunized against diphtheria, he will not produce any kind of antitoxin except diphtheria antitoxin; and that when immunized against tetanus, he will produce only tetanus antitoxin.

So much for the production of diphtheria and tetanus antitoxins, and how they are used in the treatment of these diseases. There is also another use to which these antitoxins are put, however, and that is to immunize persons against diphtheria or tetanus and thereby prevent the disease. When diphtheria occurs in a family, for example, the child having the disease is given *curative* (large) doses of antitoxin. That disposed of, attention is then turned to the other children who have been exposed to the disease. The older practice was to give each one of them an *immunizing* (small) dose, but lately that practice

is not so common. It is now known that not all children are susceptible to diphtheria, and it would be useless and expensive to give antitoxin to those not susceptible to the disease. There is a test known as the *Schick test* by which the doctor can tell which children are immune to diphtheria. This test is applied and then antitoxin is given only to those who are susceptible to the disease.

Likewise when a person develops tetanus, the tetanus antitoxin is given in large doses, but when one merely gets a wound that is likely to be infected by tetanus germs[1] an *immunizing* (small) dose of tetanus antitoxin is given to prevent the disease. Immunity that is conferred by an antitoxin is called *passive immunity*, whereas that conferred by the use of attenuated germs is called *active immunity*. Passive immunity is not usually so long-lasting as active immunity.

[1] "In nature the tetanus bacillus has been found by Nicolaier and others to occur in the superficial layers of the soil. The earth of cultivated and manured fields seems to harbor this organism with especial frequency, probably because of its presence in the dejecta of some domestic animals." Hiss and Zinsser.

CHAPTER FIFTEEN

Inter-influence of Disease

It has long been recognized that some diseases exert their own direct influence, and also an indirect influence through some other disease. Hookworms, for example, cause very few deaths, directly. In 1918 there were only 29 deaths from hookworms reported in the Registration Area of the United States. But there is little doubt that through its devitalizing influence it does increase the number of deaths from other diseases, such as malaria, typhoid, and tuberculosis. Indeed, from Kofoid's recent study of the influence of hookworms, it now seems certain that they were of great importance in increasing the death rate among the soldiers during the World War, and that they also increased in the training camps the sickness rate from measles, laryngitis, tonsillitis, bronchitis, and pneumonia.

While hookworm and a few other diseases thus indirectly influence to some extent the death rate, it is the respiratory diseases — tuberculosis, pneumonia, and influenza — that seem to cause the most trouble in this respect. In 1917 there were, in round numbers, 110,000 deaths from tuberculosis in the Registration Area, 74,000 from pneumonia, and 12,000 from "flu." That was an ordinary year, and not characterized by any special epidemic. Influenza took its place just above measles and whooping-cough in the number of deaths that it

caused. But in 1918 there was a great epidemic of influenza that spread all over the world. The number of deaths in the Registration Area mounted up from 12,000 to 232,000! This undoubtedly exerted a profound influence on the other respiratory diseases. At any rate, tuberculosis mounted up from 110,000 in 1917 to 121,000 in 1918! The increase in pneumonia was still more pronounced, the deaths from that disease mounting up from 74,000 in 1917 to 167,000 in 1918!

CHAPTER SIXTEEN

Tuberculosis

The books and pamphlets that have been written about tuberculosis would fill a library, but if you were to read such a library through and jot down the really important things, your notes would hardly fill a page. They would read about as follows:

Caused by germs known as *tubercle bacilli.*

Germs may attack any part of the body.

When they attack the lungs, the disease is called "consumption."

When they attack glands, as in the neck, it is called "scrofula."

When they attack the spinal column, it is called "Pott's disease."

When they attack the hip, it is called "hip-joint disease."

Abscesses caused by *tubercle bacilli* are called "cold abscesses."

Consumption is the commonest form of the disease.

Time contracted: usually in childhood.

Develops into active cases chiefly from 15 to 30 years of age.

Maximum number of deaths occur between 30 and 39 years of age. After being contracted, it lies dormant for a certain period, during which time no germs are given off. At this time the disease is called a "closed case."

Whenever it develops and begins to discharge germs, it is called an "open case."

All cases are closed cases before becoming open. Closed cases are not contagious.

Many closed cases recover without ever becoming open. Such recovered cases leave scars in the lungs. This fact gives rise to the German saying, "Every man has tuberculosis before he dies."

The disease is found in all parts of the world.

It causes more deaths than any other one disease.

One form of tuberculosis attacks cattle.

A form attacks birds, as parrots and chickens.

A form attacks fishes.

One form even attacks turtles.

Tuberculosis of cattle attacks man.

Man spreads the germs by coughing them up and spitting them out.

Cows do not spit, hence the germs are not spread in that way. Instead, they are spread by being swallowed and passed in the feces.

Two ways of preventing the disease:

1. *Prevent the spreading of germs.*
    a. From human beings, by hospitalization of the sick. Should be done by state.
    b. From cows, by testing all dairy cattle for tuberculosis. Should be supervised, at least, by state.
2. *Prevent closed cases from lighting up into open cases.* Should be done by individual. Best accomplished by general hygienic measures and above all by keeping body weight to approximately normal.

CHAPTER SEVENTEEN

The So-called Madstone

Of the various superstitions known to the author in connection with any of the diseases discussed, the most pronounced pertain to hydrophobia. One superstition is that hydrophobia is at its worst in dog-days. Another is that if a person is bitten by a dog, and the animal later "goes mad," the person will also go mad. But the most outstanding of these superstitions is that a "madstone" will cure rabies, and because this superstition is so strongly intrenched in the minds of many persons, it will be discussed somewhat in detail.

Though few know what a madstone is, many believe in its virtues. Every little while one sees in the press reports that a hydrophobia victim has been taken somewhere to have a madstone applied. Near Water Valley, Mississippi, is an old gentleman who has a madstone that I once had the privilege of holding in my hand. It is about the size and shape of a half walnut, with the split side slightly concaved. It is light in weight, entirely unlike a stone, fissured with small cracks, and of an ashen color. With the point of my knife, even at the risk of arousing my host's anxiety, I determined that it was soft enough to flake off. The story goes that the owner's father got it from a deer, killed in the swamps of Arkansas many years ago. The point of the deer's heart, he said, rested in the little depression in the flattened side of the "stone."

Extolling its virtues, the old man told me that his madstone would cure snake bites as well as the bite of a dog. He had cured many snake bites with it. Asked what kind, he said "chiefly spreading adders." (It should be noted in this connection that the "spreading adder" or "hog-nosed snake" is not poisonous!) He prized the madstone very highly — had even refused $300 for it, he said. His price for applying it for the bite of a dog was $25, but now that other things had gone up so, *his price also had gone up to $35*. He charged $5 for applying it to a "spreading adder" bite.

There is another madstone at Jackson, Mississippi, of which I have a photograph, furnished me by the granddaughter of the owner. I have no history of this stone.

To determine how many people believe in a madstone, I have tested about 2000 individuals, and find that 37 per cent of those tested would resort to its use.

As to what the madstone really is, I could not say certainly; but the one that I saw is, in my opinion, a dried clot of blood. I fancy gall-stones may sometimes function in this reputed rôle.

I have heard it said that madstones are taken from the stomachs of deer or cows, and are in part an accretion of hairs that get into the stomach when the animal licks itself.

GLOSSARY

Actinomycosis (ak-tin-o-my-ko′sis). From the Greek, *aktin*, a "ray," and *mukos*, a "fungus." The germ of the disease is often called the *ray fungus*. Common names of the disease: "big-head" and "lumpy-jaw." First observed in cattle. Looks like one or several big abscesses about the head or jaw, only these swellings do not disappear. Affects man very much the same way. Not common.

Anchylostomiasis (ang-ky-lo-sto-mi′a-sis). (*See* Hookworm.)

Anthrax (an′thrax). From the Greek, *anthrax*, meaning a "coal" or "boil." A disease of cattle, sheep, goats, and other animals, but occurs also in man. Other common names: "malignant pustule" and "wool-sorter's disease." When man gets it, it is usually from handling wool or hides. Occasionally got from a shaving brush.

Bacillus (ba-sil′us). Plural, *bacilli*. A germ shaped like a corncob. *Streptobacillus* (strep′to-ba-sil-us). A group form of bacilli in which the members are arranged end to end in a chain.

Bacteria. Singular, *bacterium*. (*See* Germ.)

Cancer. A disease of unknown origin, causing many deaths, particularly among people past middle life. A cancer cannot be cured but can be removed when not too large or inaccessible, and the wound will heal. If all the cancer tissue is removed, the cancer will not return; but if the slightest bit is left, recurrence is certain. The best way to remove cancer is by operation or by the application of radium, though it is sometimes successfully removed by so-called "cancer paste" (the latter treatment is hazardous, however). Sometimes cancers are so located that operation is impossible; in such cases the X-ray or radium is resorted to. (*See* page 40.)

Carrier. (*See* page 45.)

Chancroid. (*See* page 29.)

Chicken-pox. The more technical name is *varicella*, which is the diminutive of *variola*, or smallpox. A mild eruptive disease of children. Very common. Not very important in itself, causing few or no deaths; but mild cases of smallpox are often thought to be chicken-pox, and in this way smallpox epidemics get started. It is therefore thought best to require that chicken-pox be reported to the health authorities.

Cholera (kol′er-a). From the Greek, *kole*, meaning "bile." There are three forms of cholera to be reckoned with:

(*a*) *Cholera infantum*, also known as *summer complaint*. Attacks infants and young children, causing severe abdominal pains, purgation, vomiting, fever, and great prostration. Responsi-

ble for a great many deaths, although not generally considered communicable and not usually notifiable.

(*b*) *Cholera nostras*, commonly known as *cholera morbus*. Affects adults very much as cholera infantum affects children. Not communicable and not notifiable, except when Asiatic cholera is present.

(*c*) *Asiatic cholera*. Always notifiable. Common in India and other parts of Asia, where it occurs in great epidemics, often causing hundreds of thousands of deaths. There was a great epidemic of it in London in 1854. In Hamburg, Germany, in 1893 there was an epidemic that lasted two months, during which time there were over 17,000 deaths. Asiatic cholera is due to a minute vegetable organism, the spirillum (*see* page 8) of Asiatic cholera. The great epidemics of this disease are usually due to the fact that the drinking-water supplying large communities in some way becomes contaminated with sewage.

Hogs have cholera, and so do chickens, but these forms of the disease are entirely different from the disease affecting man. (*See* page 16.)

Coccus (kok'us). Plural, *cocci*. A spherical bacterium. *Diplococcus* (dip'lo-kok-us). A group form of cocci, arranged in twos. Gonorrhea, meningitis, and pneumonia are caused by diplococci known as "gonococci," "meningococci," and "pneumococci," respectively. *Staphylococcus* (staf'il-o-kok-us). A group of germs that arrange themselves in clusters like a bunch of grapes. *Streptococcus* (strep'to-kok-us). A group of germs that arrange themselves in a chain, like a string of beads.

Continued fever. Not a disease in itself. When a doctor cannot tell whether a given case is typhoid, or malaria, or something else, and the disease hangs on for 7 days, it is reported as "continued fever."

Dengue (den'gay). Also called "break-bone fever." Patients describe the symptoms as feeling "as if every bone in the body were breaking." In the Southern states it occasionally occurs in epidemics. Persons rarely — perhaps never — die from it. In former times when yellow fever used to break out every few years, and the fear of it was hanging over the South, an outbreak of dengue was looked upon with very great suspicion lest it should prove to be yellow fever. It is now agreed that dengue is transmitted by mosquitoes, and by the same kind of mosquito that transmits yellow fever, the species known as *Ædes calopus*.

Diphtheria (dif-the'ri-a). From the Greek, *diphthera*, "skin" or "membrane." An acute disease, very contagious. Formerly called

in some sections "choking complaint," because of the severity of the throat symptoms. Caused by little rod-like germs in the throat. (*See* page 45.)

Dysentery (dis′-en-ter-e). There are two kinds of dysentery:

(*a*) *Amebic dysentery*. Caused by very minute animal organisms in the intestines. This kind is chronic, sometimes lasting for years; persons who have it are liable to develop abscess of the liver. (*See* page 16.)

(*b*) *Bacillary dysentery*. Caused by a bacillus in the intestines.

Encephalitis (en-sef-a-li′tis). From the Greek, *kephale*, "head," combined with *itis*, which means an inflammation. A febrile disease (that is, involving a fever), the locus of which is the brain. Causes a variety of nervous symptoms, such as prolonged sleep or drowsiness, excessive talking or laughing.

Epidemiology (ep-i-dem-i-ol′o-gy). A knowledge made up of all the facts that deal with epidemics. The spread of communicable disease is conditioned by many and varied factors. A milk-borne epidemic of typhoid fever, for instance, would follow the milk route of the offending dairy, while a water-borne outbreak would be distributed wherever the infected water was used. Malaria, on the other hand, being mosquito-borne, would have an entirely different set of limiting factors, hookworms would have still another, smallpox another, and so on. Epidemiology has to do with all these factors.

Favus. From the Latin, *favus*, "honeycomb." One of the "ringworms." Forms crisp, yellowish, cup-like crusts on the scalp. Rare in this country, but more common among certain classes in Europe. Of enough seriousness to bring it within the notifiable class, and when found among immigrants it is cause for exclusion.

There are several other forms of ringworm, which although not notifiable are common and of more consequence than is generally supposed.

German measles. Also called *rubeola* and *roseola*. A mild eruptive disease, bearing about the same relation to measles that chicken-pox does to smallpox.

Germ. (*See* page 3.) The quotations from Hill, below, sum up three of the more important facts concerning germs:

"Germs of all kinds are simply tiny plants (or animals); some spherical, some more or less sausage-shaped. . . .

"Germs of any kind never 'evolve' from dirt. They, like other plants (or animals), come only from predecessors. . . .

"Many different kinds of germs that do not produce disease flourish on or in our skins, noses, mouths, and intestines all the time."

Glanders. A very contagious disease of horses and particularly of mules, in which it is usually acute and rapidly fatal. It is communicable to man. When a case of glanders occurs at any place in the state, the matter is at once reported to the Live Stock Sanitary Commission of that state; or if the state has no commission, it is reported to the State Board of Health and to the Bureau of Animal Industry in Washington. Steps are at once taken to stamp it out. In 1907 an outbreak occurred in Cook's Stables, Jacksonville, Florida. Some 80 horses and mules were found to have the disease. They were taken out to the woods, a great trench dug, and the animals were killed and piled in the trench, covered with lime, and buried. For those who want to know the rest of the story, it might be added that when the next session of the Florida legislature met, Mr. Cook had a bill introduced through which he hoped to obtain payment for the loss of the animals. His argument was that he had killed them to keep the disease from spreading, and in that way had protected the rest of the state. The counter argument was that the horses were sick and dying, and were of no value, hence the state should not reimburse him, even in part. This incident illustrates the seriousness of an epidemic of glanders when once it gets started.

Hookworm disease. Caused by small worms (the so-called "hookworms") in the intestine. Several animals also have hookworms, as the dog and the cat; but these hookworms are not all alike, each kind of animal having its own kind of hookworm. Man has two kinds, known respectively as the *Old World hookworms* and the *New World hookworms*, or the *European* and the *American*. (*See* page 38.)

The hookworms of man inhabit a zone that belts the earth between an irregular line at about 40 degrees North latitude and a similar line about 40 degrees South latitude. Persons living in this zone are more or less liable to get the infection.

There can be no spread of hookworm disease except through soil pollution. (*See* page 16.)

Immunity. When a person is spoken of as being immune against a disease, it means that he will not take it however much he may be exposed. For example, when a person is vaccinated against smallpox he becomes immune against that disease and will not take it. There are certain diseases, however, to which man is not susceptible. Chicken cholera is one of these. Man's relation to such diseases is spoken of as *natural* immunity. When one is immunized against a disease by vaccination, or by having the disease, that condition is called *acquired* immunity.

Incubation period. That period of time between the exposure to a disease and the onset.

Influenza. One of the acute infectious diseases which in a most malignant form assumed world-wide proportions during the World War. The very high death rate was due to the large proportion of cases that developed pneumonia.

Leprosy. The points to remember about leprosy are that it is caused by "germs," which are known as the *lepra bacilli;* that it is accordingly contagious, but so mildly so that people may sometimes live with it for years without ever contracting it; that it is not hereditary; that it is not white, as many suppose; that it is a slow chronic disease, often lasting 15 or 20 years; and that there are some 200,000 cases in the world. Most of these cases are in the Far East — about half of them in India and China. There are five or six thousand cases in the Philippines. In 1909 there was an International Leper Congress held at Bergen, Norway. At that time 135 cases were reported from the United States. These were distributed in various centers, the largest of which was in Louisiana. There were some 40 cases in this center. Other centers were at Key West, Florida, and in Minnesota, California, and Massachusetts; the rest were distributed here and there over the country. The United States has lately taken over the leper sanatorium in Louisiana, so that lepers from any part of the United States may now be taken care of there.

An interesting light on the disease comes from Hawaii. There are two schools in Honolulu for the non-leprous children born of leprous parents. All the lepers in Hawaii are sent to the Island of Molokai, where there is quite a large and happy colony of them. Whenever a child is born there of leprous parents, it is immediately taken back to Honolulu and put in one of these schools for such children. There are about 40 boys in one school and about as many girls in the other, and yet not one of these children has ever developed leprosy.

Malaria. The outstanding facts about malaria are:

(*a*) It is transmitted by mosquitoes and in that way only. People do not get it from swamps or from night air, or from eating muscadines, or late watermelons, or from eating anything else — *it is got from mosquitoes only.*

(*b*) Mosquitoes likewise do not get it from swamps, or night air, or from eating muscadines or late watermelons — *they get it from man, and from man only.*

(*c*) Only certain kinds of mosquitoes can transmit it — those known as *Anopheles.*

(*d*) An Anopheles cannot transmit it until he bites some person who has it — gets "loaded," so to speak. A loaded Anopheles can give malaria; one that is not loaded cannot.

(*e*) *The protection of the patient from the bite of Anopheles during the whole term that he is a carrier also protects the public round about him.*

(*f*) Chills and fever may usually be taken to be malaria.

(*g*) A person having had malaria for some time may still carry in his blood the germs of malaria after the chills and fever have stopped. In that case he is called a "malaria carrier." Although he himself is well, or relatively so, if a mosquito of the right kind bites him the mosquito will get the germs and then pass them on to some one else. It is important, therefore, to treat malaria or "chills and fever" very vigorously, and to get the patient well as soon as possible so that he will not become a carrier.

(*h*) *It is not the cause of every obscure ache and pain that human flesh is heir to.*

(*i*) Quinine is the basis of all malaria treatment. As the late Dr. Eugene Foster used to say, in the treatment of malaria use quinine "internally, externally, and eternally."

Measles. One of the eruptive fevers. Causes relatively few deaths in itself, but during the disease pneumonia not infrequently develops and ends disastrously. "Big" measles and "little" measles mean the same thing. "Black" measles is also the same disease but in a very aggravated form. The black feature is due to the rupture of small blood vessels and consequent bleeding under the skin. This may also occur in other diseases, as smallpox, scarlet fever, and meningitis. There was a terrible outbreak of disease in London in 1666, known as the "Black Plague." It was probably one of these diseases just mentioned — possibly smallpox.

Meningitis (men-in-jī′tis). Also known as "cerebrospinal fever" or "spotted fever." Occurs in epidemics, which are more or less local. Regarded as contagious. Called spotted fever because some of the cases have hemorrhages under the skin, making dark spots. After a person gets over a severe case, he is still likely to have some of its effects. Patients are often left cripples. One young man of the author's acquaintance was left cross-eyed.

Microbe. Another name for germ. (*See* Germ; *also* page 3.)

Mumps. An acute disease of the parotid and salivary glands, which swell and become extremely painful. The disease does not last very long — 3 or 4 days to a week. It sometimes affects the generative organs of both male and female; in that case it is a dangerous malady.

Paratyphoid. Much like typhoid fever; the difference is more in the germ than in the disease. (*See* page 16).

Plague, or *bubonic plague*. Essentially a disease of rodents (rats, squirrels, and related animals). Transmitted from rat to rat and from rat to men by fleas. The disease has long prevailed in the Orient, particularly in India. It has appeared in the United States only a few times. About 1903 or 1904 it was introduced into California, and since then has appeared twice in New Orleans and other Gulf ports. A vigorous campaign of rat-killing has eradicated the disease each time it has appeared in this country, although it is said still to exist among California ground squirrels.

An outstanding feature of plague is its method of traveling from country to country. It seems to be carried exclusively by the Norway rat, which, by the way, is a great traveler, by boat and by rail. If plague-infected rats go aboard a boat and other rats on the ship get infected, the disease may develop at sea. Then at any port where the boat touches, the rats may disembark and introduce the disease.

Pneumonia. Aside from tuberculosis, this disease causes more deaths than any other in this country. The death rate from pneumonia is generally higher in the colder latitudes than in the warmer. The fever runs high, and the breathing is very rapid. In about 5 to 8 days from the onset there occurs what is called the "crisis." The patient breaks out in a profuse sweat, the temperature falls rapidly to normal or below, and the patient goes into a state of collapse. It is at this juncture that most deaths occur. If the patient can get through the crisis all right, he will probably recover. One student, when asked what pneumonia was, replied: "A kind of cold in the lungs." The description is good.

Poliomyelitis (pol-e-o-mi-e-lī'tis). From the Greek words *polios*, "gray," and *muelos*, "marrow"; combined with *itis*, meaning an inflammation; literally, "inflammation of gray matter." Commonly called *infantile paralysis*. This disease is very insidious. The child complains of not feeling well — perhaps does not eat any breakfast, and is disinclined to play. In a day or two it is noticed that he is partly paralyzed in one or more limbs. As the paralysis is caused by the destruction of the nerves in the spinal cord that lead to the muscles, there is little that can be done for it.

Rabies, or *hydrophobia*. Transmitted through the bite of an animal infected with rabies. Once developed, the disease is always fatal. It is usually about 4 weeks — sometimes more, sometimes less — from the time the person is bitten until he develops the disease. If during this time he takes the Pasteur treatment (the only effective method of vaccinating against rabies), he will not be likely to develop rabies. But it takes 3 to 4 weeks to give the Pasteur treatment; so there is no time to be lost. If you are bitten by an

animal and are not sure whether it is rabid or not, the thing to do is to begin the Pasteur treatment at once — *do not wait.* Then, shut up the animal to keep him from biting any one else, or other animals, and watch him for further symptoms of rabies. If he has the disease, he will die in 3 or 4 days. If he does not die in a week, you will know that it is not rabies, and you can drop the treatment. Above all things *do not kill the dog.* You can be much more certain by watching him than by sending his head to the laboratory. If you do kill the dog, you will have to complete the Pasteur treatment regardless of what the laboratory finds. If you do not kill the dog, you may be able to drop the treatment in a week or so.

Rocky Mountain spotted fever. (*See* pages 28 *and* 39.)

Scarlet fever. (*Scarlatina* is only another name for the same disease.) One of the eruptive fevers. Characterized by sore throat and a scarlet rash. In later stages of the disease the epidermis (outer skin) sheds off more or less. In some cases the hands peel off almost like taking off a glove. In mild cases there is not much of this shedding, or "desquamation" as it is called in books.

Scarlet fever sometimes injures the hearing. There is a little tube running from the throat to the ear that enables air to get to the middle ear. It is called the Eustachian tube. When it becomes inflamed, as it often does in scarlet fever, it may "grow together," so that air cannot pass through it. Inflammation of the middle ear is a common complication; in that case hearing may be permanently damaged.

Septicemia. In typhoid, child-bed fever, and some other conditions, the germs causing the disturbance exist and multiply in the blood stream. Such conditions are spoken of as "septicemia."

Smallpox. A disease that has always been looked on with great dread. Formerly a most terrible scourge, but now comparatively unimportant. Sometimes today a case is fatal, but not often. Can be prevented by vaccination. It is customary to make some attempt to quarantine it, but as a general rule that does little, if any, good. Only about one out of every four cases is ever reported to the health officer. It is perfectly obvious that to quarantine one case and leave three at large will do very little good in checking its spread. Every one who wants to keep from having smallpox should be vaccinated against it and keep on getting vaccinated until it "takes." If it does not "take," it does not show that you are immune against the disease — it more probably shows that the vaccine was dead. And it is not true that people sometimes have to have the arm taken off because of vaccination — that never happens. (*See* page 53.)

Tetanus, or ***lockjaw.*** A disease that is caused by the germ of tetanus. The germ gets into a wound, particularly the deep or

"puncture" wounds, and the poison that comes from their growth acts on the nervous system, causing the muscles to contract; hence the jaws seem locked. The tetanus germ is particularly prevalent about stables. Puncture wounds received about barns should be promptly attended to.

Lockjaw can be prevented by the use of tetanus antitoxin, which is in the market. All persons who get suspicious wounds will be safe if they take an injection of this germ, which is called "anti-tetanic serum." Gunpowder wounds are particularly dangerous sources of tetanus. (*See* page 58.)

Trachoma. A disease of the eyelids. Often called "granulated lids," but there are many cases of "granulated lids" that are not trachoma. True trachoma is such a serious disease that persons who have it are not permitted to come to this country as immigrants. At Ellis Island, where most of the immigrants land, all are examined and those found to have trachoma are sent back. There are some cases in this country, however. It is fairly amenable to treatment by operative procedure.

Trichinosis (trich-i-no'is). Most commonly a disease of hogs and rats. Very rare among human beings in the United States. A tiny worm, the *trichinella spiralis*, causes the disease. There are thousands of them coiled up in the muscles of a single infected animal. It is this that causes "measly pork." When a person eats such pork without sufficient cooking to kill the worms, he gets the disease himself. In man it is somewhat like rheumatism in its effects. At the packing houses all pork is examined for these little worms, and whenever found, the carcass is condemned.

This is another disease in which the rat is often involved. Rats eat scraps of meat and get the infection. Pigs may eat rats, and man eats the pigs. The disease is more interesting than important.

Tuberculosis. (*See* page 61.)

Typhoid fever. A long-drawn-out fever lasting usually from 3 to 6 weeks. Caused by a vegetable germ, the typhoid bacillus. These germs are passed from the body of the patient by millions, in the saliva, in the urine, and in the stools. Consequently all sewage is to be regarded as typhoid infected. And if through any means it contaminates the drinking-water, persons drinking this water will have typhoid fever. This may happen when a surface privy is close to a well. The sewage from the privy seeps down when it rains, and gets into the well. Or it may happen from emptying sewage into a river and taking water from the river for domestic use. All such water should be filtered by the city. Typhoid is often spread when flies have access to open privies. They go there to feed, get the germs on their feet, and then come into the dining room and walk over the food.

Sometimes a person may get well from typhoid and still give off the germs for weeks or months, or even years. Such persons are called "typhoid carriers." If a typhoid carrier works in a dairy or as a cook, or otherwise handles food, there is danger of spreading the disease. It is customary now to examine all milkers in large dairies to make sure that they are not typhoid carriers. Many epidemics of typhoid have been caused by carriers.

It is possible now to be effectively vaccinated against typhoid. (*See* page 49.)

Typhus. Also known as "jail fever." Transmitted by both head and body lice. Caused many deaths during the recent war. Not common in the United States. Caused only 16 deaths here during the year 1917. Every precaution is taken at Ellis Island and other immigration stations to prevent its accidental introduction.

Venereal diseases. There are three venereal diseases: *syphilis, gonorrhea, chancroid.* All are contracted by sexual contact. These diseases are the most terrible of all diseases, causing a great deal of suffering — insanity, blindness, disabilities, and deaths — both directly and indirectly.

It should be clearly understood that *no one who lives a clean sexual life is in danger from these diseases.*

On page 30 there is a table listing the most salient features of the venereal diseases; if you wish to know more about them, ask your family physician — he will be glad to tell you all about them.

Whooping-cough. A widely known disease, and much more serious than generally considered. In 1917, for example, in the list of communicable diseases it stood eighth as a cause of deaths. It caused more deaths that year than scarlet fever, malaria, smallpox, hookworms, and hydrophobia combined. It is particularly fatal among infants and very young children. It should never be considered lightly. *And above all, children should not be exposed to it to "get it over."*

Yellow fever. A disease that is now of more historic than practical interest. It used to prevail in Cuba constantly, and every year or so it was introduced into the United States. All sorts of theories were proposed as to how it spread. But in 1900 a commission headed by Walter Reed of the United States Army, working in Cuba, proved that it was transmitted by mosquitoes, of the genus then known as *Culex fasciatus*, but which is now known as *Ædes calopus.*